Remarks

The Applicants have amended Claims 2, 10 and 12 to place them into conformance with independent Claim 1. Thus, no additional issues have been raised, no further searching is required and the amendments place the entire Application into final condition for allowance.

The Applicants note with appreciation the withdrawal of the previous objection to Claim 5, the double-patenting rejection and the rejection of Claim 1 under 35 U.S.C. §103 over Maid.

Turning now to the merits, this invention resides in the art relating to hot-rolled steel sheets, having concurrently excellent workability and high superior strain aging hardenability, suitable in use for automotive bodies. Steel sheets of this invention are soft while being processed by press forming. Hence, the generation of cracking and necking are suppressed, thereby improving accuracy in size. The steel sheet becomes hard after press forming due to strain age hardening occurring in the paint baking step and the hardness contributes to the improvements in impact resistance and fatigue resistance. Strain age hardening referred to herein means not only an increase in YP, yield point, (= BH) but also increase in TS, tensile strength (= | TS). For increasing impact resistance and fatigue resistance, an increase in only YP is insufficient, but an increase in TS is obligatory. The increase in YP only improves elastic deformation strength alone, whereas plastic deformation strength is not improved. The increase in TS improves plastic deformation strength. The strength of an automotive body at collision is determined by plastic deformation strength. Increase in TS is a new function of a steel sheet which has never been secured.

To achieve an increase in TS, all of the following elements of the invention should be totally satisfied:

(1) Al content of less than 0.02%,

(2) N content of 0.0050 to 0.0250%,

(3) N/Al is 0.3 or more,

(4) N in a solid solution state is 0.0010% or more, and

(5) average crystal grain size is 10 μm or less.

The Applicants respectfully submit that the prior art fails to teach or suggest this claimed combination.

The Applicants acknowledge the rejection of Claims 1 – 5, 10, 12 and 14 – 15 under 35 U.S.C. §103 over the hypothetical combination of Tosaka with Maid. First, the Applicants agree with the Examiner's frank acknowledgment that Maid does not disclose the claimed N/Al ratio, the amount of dissolved N and the ferrite grain size in Claims 1- 2 and 10, does not disclose Nb in Claim 12 and does not disclose electroplating or hot-dip plating a steel sheet in Claims 14 – 15.

The Applicants respectfully submit that Maid fails to disclose other aspects as well. For example, Maid discloses 0.02 – 0.10% Al. The solicited claims all recite less than 0.02% Al. In that regard, the Applicants note with appreciation the Examiner's helpful comments concerning certain aspects of Maid and the Al content. The Official Action states that "less than 0.0 wt% is no different from 0.02 wt%." The Applicants disagree. There must be an overlap or at least one point of identity between two ranges of numbers for them to not be different. In this case, less than 0.02 is different from 0.02 or 0.02 or more. To state otherwise denies fundamental realities of number systems. Thus, the Applicants respectfully submit that there are at least four differences between Maid and the Applicants' solicited claims.

The Official Action also takes the position that the claimed quantity of dissolved N "would have been inherently possessed by alloy steel of Maid since the claimed N content and

other alloying elements' content are overlapped." It is well settled that, for a claimed characteristic to be inherently present, the characteristic must necessarily be present. Further, the statement of inherency must be supported by an explanation in the rejection in a way that demonstrates that the inherent characteristic would necessarily be present. The rejection bases the inherency on the notion that the claimed N content and other alloying elements' contents are overlapped. The Applicants respectfully submit that such a basis is utterly inadequate to form an inherency argument that the dissolved N content would necessarily be present based solely on the claimed N content and other alloying elements.

Those of ordinary skill in the art are well aware of the fact that N is contained in steel in several ways. One way is in a dissolved form and another way is in a precipitated form. The raw content of N is not determinative of whether the presence of N is in dissolved form or in precipitated form. Those of ordinary skill in the art simply cannot tell how much of the N will be dissolved or precipitated based on the numerical content.

The N content in one form or another may be influenced by the content of other alloys, especially Al. Formation of AlN is well known in the art. However, the Applicants' claimed Al quantity is different from the Al quantity of Maid. Inasmuch as Al is well known to have an influence on the quantity of dissolved or precipitated N, one of ordinary skill in the art could reasonably come to the conclusion that the dissolved N content in the claimed invention would necessarily be different from the dissolved content of Maid in view of the differences in the amount of Al present. This directly rebuts the unsupported assertion in the Official Action that the dissolved N content would be the same or would be inherently present in the alloyed steel of Maid since the claimed N content and other alloying contents overlap. The overall alloying contents, especially the one that matters significantly, namely Al, does not, in fact, overlap. This

alone destroys any potential inherency argument based on Maid. Again, the inherency must necessarily be present. In this case, the Applicants have already demonstrated that the inherency is not likely to necessarily be present.

In any event, there are further factors that influence the amount of dissolved/precipitated N such as process steps. Various of those processing steps can dramatically influence the presence or absence of dissolved/precipitated N in the steel. This introduces a wide variety of possibilities into the amount of dissolved N that is potentially present. It would be nothing more than speculation, as opposed to the need for the inherently present physical characteristic to necessarily be present. According to the actual experimental results in Maid, the N content is 0.006%, Al content is 0.025% and N/Al is 0.24 (Table 1) and these values do not satisfy the necessary elements (1) and (3) mentioned above. Al has an operation of combining with N and reducing the content of solid solution N and said operation is conspicuous in proportion to the increase of Al content. With Maid, the Al content and Al/N do not satisfy the composing elements even when N content meets the above elements of the invention and sufficient obtainment of solid solution N is considered to be quite difficult. Consequently, even with the effect of increase of BH, which is a conventionally exercised function, strain aging hardening, as high enough to increase TS, is unable to be materialized.

Moreover, in Maid, although crystal grains are set forth as fine, an actual description of crystal grain size is not disclosed therein.

Tosaka is hypothetically combined with Maid because Tosaka discloses stretch flanging properties of alloy steel allegedly having a composition similar to Maid that is made by hot-rolling, cold-rolling and hot-dip galvanizing and can be improved with fine grain ferrite having a grain size less than 20 μm. Although the Applicants agree that Tosaka does in fact disclose

stretch flange flanging property of alloy steels made by hot-rolling, cold-rolling and hot-dip galvanizing to produce fine grain ferrite, and that the steels of Tosaka have proven to be useful in a variety of circumstances, the Applicants respectfully submit that the steels of Tosaka are inapplicable to this invention and are also inapplicable to Maid. Accordingly, the Applicants respectfully submit that one of ordinary skill in the art would not make the hypothetical combination of Tosaka with Maid. A primary reason is simple: Maid discloses a hot-rolled steel sheet and Tosaka discloses a cold-rolled steel sheet. As previously noted, those of ordinary skill in the art are well aware that the physical characteristics of such steel sheets are quite different from one another. This fact does not attempt to hinge patentability based on the differences in methods between hot-rolling and cold-rolling. Instead, the differences in physical characteristics between hot and cold rolled sheets are well known facts that would cause one of ordinary skill in the art not to make the hypothetical combination posed in the Official Action.

The Applicants note with appreciation the Examiner's most helpful comments at the bottom of page 5 concerning the fact that the hot-rolled steel of Maid has "good uniform cold workability," and the like. There is no question that such steels can be subsequently cold-worked. However, in the context set forth in Maid, such cold-working is in no way referring to cold-rolling, which would clearly change the characteristics of the hot-rolled steel. Cold-working in that context merely refers to what may occur to the hot-rolled sheet once it is sold to an ultimate consumer and formed into its ultimate shape for its ultimate purpose. The act of cold-rolling, however, would no doubt dramatically change the physical characteristics of the hot-rolled sheet into characteristics typical of cold-rolled sheets which would very likely not suit the purpose of the ultimate consumer when the ultimate consumer is looking for a hot-rolled sheet.

This fact brings us full circle to the initial fact that one of ordinary skill in the art would have no incentive to make the hypothetical combination of the cold-rolled sheets of Tosaka with the hot-rolled sheets of Maid. Those of ordinary skill in the art would have a highly reasonable expectation that the characteristics displayed by the hot-rolled sheets of Maid would be dramatically changed by cold-rolling and *vice versa*.

In any event, Maid utterly fails to provide teachings or suggestions to those of ordinary skill in the art as to how to form hot-rolled sheets with a ferrite phase having an average grain size of 10 μm or less. Careful scrutiny of every word of Maid reveals that there is not one word of disclosure on this point. Accordingly, the Applicants respectfully submit that Maid is utterly non-enabling to those of ordinary skill in the art with respect to how to produce a ferrite phase having an average grain size of 10 μm or less.

Hypothetically combining Tosaka with Maid does not change the deficiencies of either reference. Importantly, Tosaka does not disclose N content, solid solution N content and N/Al. Further, while a description of crystal grain size is disclosed, its scope is defined as 20 μm or less, which is two times higher than the scope of crystal grain size of this invention. According to the actual experiment results of Tosaka, no results concerning N content and Al content simultaneously satisfying elements (1) and (2) are disclosed, while the whole crystal grain sizes exceed 10 μm. Therefore, element (5) is not satisfied. That being the case, according to an art of Tosaka, both the amount and the location of solid solution N are not considered and it is obvious that strain aging hardening which is as high as to an extent of increasing TS can hardly be actualized. Even if the art mentioned immediately above is combined with Maid and thereby an element concerning crystal grain size is added, this neither satisfies the element (5) nor cures the insufficiency of elements pertaining to the above-mentioned chemical composition. Hence,

strain aging hardening, as high enough to increase TS which is an aspect of this invention, is unable to be realized.

Careful scrutiny of the entire Tosaka disclosure reveals that the mean diameter of the ferrite grains of Tosaka are all in excess of 10 μm. In that regard, the Applicants invite the Examiner's attention to Tables 2, 3, 5, 9, 11 and 13. There are many, many Examples in those Tables and all of the inventive Examples have ferrite grain diameters greater than 10. (The Comparative Examples have grain diameters even larger still.)

What this means is that Tosaka does not provide disclosure and/or teachings to those of ordinary skill in the art as to how to make a hot-rolled sheet as claimed herein having a ferrite phase with average grain sizes of 30 μm or less. Careful scrutiny of the entire Tosaka disclosure reveals that there is not one word as to how to produce such a steel. There are several reasons for this. First, Tosaka provides teachings only with respect to cold-rolled steel sheets. That is not what the Applicants claim and that is not what Maid discloses. Further, there is no disclosure of how to make ferrite phase grain sizes of 10 μm or less. There is simply no disclosure in Tosaka on the point of how to do this. As mentioned above, Maid similarly provides utterly no disclosure on this point.

The question therefore arises: Would one of ordinary skill in the art, in attempting to produce a hot-rolled steel sheet having a ferrite phase with an average grain size of 10 μm or less, hypothetically combine Tosaka with Maid and, if one of ordinary skill in the art were to make such a hypothetical combination, would such a person of ordinary skill in the art have a reasonable expectation of success? The Applicants respectfully submit that the answer is a resounding "No!" One of ordinary skill in the art would not hypothetically combine teachings associated with cold-rolled sheets with those of hot-rolled sheets. Thus, the combination would

not be made in the first place. Also, one of ordinary skill in the art would, at best, have the reasonable expectation that the average grain size would be more than 10 μm based on the teachings of Tosaka. Although the Applicants' fully agree that Examples are merely Examples, there are many Examples in Tosaka that provide the following mean diameter of ferrite grains: 14, 14, 12, 13, 11, 12, 13, 14, 14, 14, 14, 13, 12, 19, 17, 19, 17, 17, 17, 17, 17, 15, 17, 15, 13, 12, 12, 15, 15, 13, 14, 12 , 13, 18, 17, 18, 18, 17, 18, 17, 17, 15, 18, 18 and 15. These teachings to those of ordinary skill in the art cannot be ignored. It is clear from the Tosaka disclosure that one of ordinary skill in the art would have no reasonable expectation that a ferrite phase having average grain size of 10 μm or less would be produced in accordance with the teachings of Tosaka, whether taken alone or in conjunction of Maid. Accordingly, the Applicants respectfully submit that one of ordinary skill in the art would have no reasonable expectation of success of producing a hot-rolled steel sheet having a ferrite phase with an average grain size of 10μor less based on the combination of the two references.

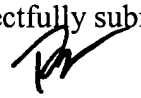
Thus, in Tosaka, the above-mentioned elements, (2) N content, (3) N/Al and (4) N in a solid solution state, are not disclosed. In Maid, (3) N/Al and (4) N in a solid solution state are not disclosed. The element of (5) crystal grain size is not disclosed even when Tosaka and Maid are combined.

The mechanism of increase in TS is presumed to be as follows: A large volume of transposition in a steel sheet is introduced by press forming. N (solid solution N) in a solid solution state concentrates in the periphery of transposition and prevents the movement of the transposition. As a result, the steel sheet is hardened. The amount and the location of solid solution N are controlled to manifest said hardening effectively. The force for preventing the movement of transposition is heightened by increasing the amount of solid solution N. The

concentration of solid solution N in the periphery of the transposition is fostered by reducing the crystal grain size. This is because, solid solution N and transposition are made mutually interactive because solid solution N is easily present in the crystal grain boundaries and transposition is readily introduced to the location close to the crystal grain boundary. An increase in TS is unable to be accomplished by merely limiting the chemical composition of a steel sheet. To increase TS, the control of both the formation and the location of the existing solid solution N is necessary. Withdrawal of the 35 U.S.C. §103 rejection of Claims 1 – 5, 10, 12 and 14 – 15 over the hypothetical combination of Tosaka with Maid is respectfully requested.

In light of the foregoing, the Applicants respectfully submit that the entire Application is now in condition for allowance, which is respectfully requested.

Respectfully submitted,



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